



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

in the dusk, for, although one may hear him at all hours, still he prefers the dim morn or the quiet twilight. The Bobolink is an early riser too, and his jolly, jingling notes add much to the chorus of bird-voices that now chant so sweet a concert on every side.

The forest birds are now awake, and from the dark, distant woods come the faint bell-like notes of the Wood Thrush, our prince of songsters. The Veery, and the Rose-breasted Grosbeak join in with him, and the woods soon ring with the notes of these three birds, who are unquestionably our finest songsters. The Vireos, who have been awake some time, lend their sweet voices to swell the choir; and as the sun rises in the sky, the concert each moment grows louder and louder. The Golden-crowned Thrush begins his hurried, ecstatic song; the Wrens, Catbirds, Orioles, Warblers, and Sparrows, all add their notes to the sylvan concert; and by the time the sun has lifted himself well above the horizon, all the birds are awake and in full song.

AGENCY OF INSECTS IN FERTILIZING PLANTS.

BY W. J. BEAL.

(Concluded from page 260.)

THERE are two other peculiarities among certain plants by which a cross-fertilization is made most probable, and even very sure in some cases, notwithstanding the flowers are all perfect and of one form.

In some of these the stigmas come out and are fertilized before the anthers of the flower burst open; while in

others the anthers are in advance, and discharge their pollen before the stigmas appear. In either case the flowers act as though they were monœcious.

These peculiarities have been termed *dichogamy* by Sprengel, who made the discovery many years ago. Of the first kind, in which the stigmas are in advance of the anthers, I examined the young flowers of several species of *Spiræa*, just before any of the anthers had opened, and in all I found the stigmas quite plentifully covered with the yellow powder. Many stigmas were dry and withered, while some of the anthers were still full of fresh pollen. Similar observations were made upon False Solomon's Seal, several species of *Potentilla*, Plum, Cherry, and others. One of the best examples of this kind was pointed out by Dr. Gray, in the case of the Plantain or Ribgrass (*Plantago lanceolata* Linn.), a troublesome plant which is too rapidly finding its way into meadows and waste places.

These flowers, in arrangement, somewhat resemble a short tapering spike of Timothy or Herd's-grass. The long hairy stigmas come out first at the base of the spike, and are quite withered and dead before the stamens of the same flowers appear in sight. By the time the long thread-shaped stamens of the lowest flowers hang out their anthers, the stigmas of other flowers higher up the spike are exposed and ready to receive the fertilizing element. So new pistils continue to come forth, keeping in advance of the stamens. The long filament raises the anther so high that it is brought near the stigmas of younger flowers farther up the spike. This plant, like most of the large Grass-family, is not visited by insects, as it secretes no nectar, but each anther is hung on a mere point (versatile) and every slight motion of the air keeps it flutter-

ing. By applying a low magnifying power, the pollen was seen with its long tube thrust into the stigma before anthers had shown themselves above the calyx. While within the calyx the filaments are folded upon themselves, which accounts for their great length as soon as they come forth.

The Broad-leaved Plantain (*Plantago major* Linn.), so common about door-yards, resembles the one above mentioned as regards its mode of fertilization.

On the long spikes of flowers of the False Indigo and Lead-plant (*Amorpha fruticosa* Linn., and *A. canescens* Nuttall), the bees and wasps were seen beginning at the base on the older flowers, and so passing up, visiting those above in which the anthers were still young and enclosed by the corolla. Here, as in the Plantain, the pistils are a day or two in advance of the stamens, and the insects are a means of affecting a cross-fertilization.

The common Dandelion (*Taraxicum dens-leonis* Desfontaines) is a good example of the other kind of dichogamy, in which the anthers discharge the pollen before the stigmas are ready to receive it. This belongs to a very large family called *Compositæ*, which contains from one-eighth to one-tenth of all the flowering plants in this part of the world. Each yellow head in the Dandelion is a cluster of small flowers packed closely together, and not one large compound flower as the name implies, which was given by the early botanists. Each pistil bears two long slender stigmas surrounded by the anthers which are united by their edges, forming a tube (*syngenesious*). The stigmas are covered on the outside with small hairs, having their tips pointing upwards, like the beards on a head of barley.

Imagine a head of barley much lengthened and split in two down the middle, and you have a good representation of the stigmas of a Dandelion. When the tips of these are just above the apex of the anthers, the pollen is discharged and carried up on the hairs by the style which grows very rapidly at this time.

The stigmas are closely pressed together until clear above the anthers, when they begin to spread and roll back, exposing the inside surface which alone is sensitive to the action of the pollen. Several kinds of bees, flies, and smaller insects visit these flowers and brush the pollen off the outside of the style, and leave some on the inside surface where it can take effect. Were it intended for close, self-fertilization, as a superficial examination would seem to indicate, the style should be shorter, and the stigmas a little separated, so that pollen would meet the proper surface before the stigmas leave the surrounding anthers. Or else the surface, which is sensitive to pollen, should be on the outside instead of on the inside.

I have examined Coreopsis, Fall Dandelion (*Leontodon*), and Succory, and many more of this vast family, which showed these same peculiarities mentioned above.

In Sweet Coltsfoot (*Nardosmia*), a rare plant of this order growing north of this latitude, some of the little flowers are sterile, i. e., the imperfect pistil bears no seed, but the top of the style has a tuft of little hairs which push up the pollen from the anther-tube that it may reach the stigmas of other flowers, and so not be entirely lost.

At the suggestion of Dr. Gray I examined some half a dozen or more species of Bellflower, or Campanula. The one most carefully noticed was *Campanula rapunculoides*.

It has five anthers which stand up close together, although not joined by their edges into a tube as in the dandelion. In three other respects it resembles this plant; namely, in having the style covered with hairs or short bristles on the outside, and in having the sensitive part of the stigma on the inside. In the same way also the style nearly doubles in length after the pollen is discharged.

The pollen begins to discharge very soon, so that by the time the corolla is fairly open, the anthers wither, and are coiled up at the base of the flower. After the hairs on the style have nearly all disappeared, and the pollen which they held has been removed, or has turned brown in decay, the stigmas separate at the top, and expose the sensitive surface. For each flower to be self-fertilizing, this plan is a perfect failure.

Bees are willing agents here, as in other instances, alighting first on the stigmas of the oldest flowers, which are farthest down the stem, and then passing up to others which are younger. Besides collecting nectar at the bottom of the flower, they collect the pollen by scraping the style upon each side with their legs, and, when calling at the next flower, first strike the exposed stigmas, leaving a few little morsels as tribute for their bountiful supply.

The flowers of the Mallow Family have numerous stamens, joined into a column or tube (*monadelphous*), through which the stigmas are protruded. My observations on this family have been rather limited, but in the High Mallow (*Malva sylvestris* Linn.), the anthers all burst, and very little pollen remains about the flower, when the stigmas first come to the light, as brides too late for the marriage, for the bridegrooms have been carried away by the priests, and perhaps wedded to others.

The fact once well established, that insects are necessary to fertilize plants, brings up some other interesting inquiries in reference to the origin of animals and plants. Some would probably say that plants, which now require the agency of insects, have arrived at their present form by a long series of gradual changes, and that before the proper insects were created they were capable of self-fertilization. Others may say that the plants of this structure were created later than those capable of self-propagation, and upon which the insects could subsist for a time. Another plan can, however, be devised, as they are alike useful to each other. "As the bow unto the cord is," they may have been called into existence at the same time, the flowers to secrete nectar for the insects, and the insects to fertilize the flowers.

Were Dr. Watts again alive, and should some one tell him these facts of science, he might well exclaim, as the Queen of Sheba did to King Solomon, "Behold the half was not told me." He gave us but half the story, and that the one which teaches the least instructive lesson. It is now over two years since some one, I wish I knew his name, rung the change,—

"How doth the little busy bee,
Improve each shining hour,
By carrying pollen day by day,
To fertilize each flower."

The bees go buzzing through the air visiting flower after flower, not only to get their daily bread, but render an essential aid in perpetuating the existence of the very same plants which furnish them food.

This furnishes another pertinent illustration of the mutual dependence of the animal and vegetable kingdoms.